

## Towards the Mid-Late Holocene Environment of Mochena Borago Rock Shelter, Wolayta, South Ethiopia

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### Abstract

*With the objective of understanding the mid-late Holocene subsistence pattern and the local ecology, archaeobotanical investigation was conducted on soil samples collected from 29 contexts from the rock shelter site of Mochena Borago. The samples were collected by the French Archaeological Mission in 2000 and 2001 field seasons. Flotation was carried out using bucket and 2.0 mm mesh size sieve. Recovered botanical remains were classified based on size and grain morphology. Seed analysis was conducted at 5-20x magnification. A total of 112 seeds and fruit stones were identified which include 55 Sapindaceae cf. Deinbollia type (dune soap-berry), 33 Myrtaceae cf. Syzigium guineense type (sometimes called waterberry), 9 Plectranthus edulis (Wolayta dinich/potato), 7 Euphorbiaceae Croton sp. (rushfoil), 2 Cordia cf. africana (wanza in Amharic), 1 Ebenaceae cf. Diospyros (commonly known as ebony trees), 1 Olea europea ssp. africana (Olive Oil). Plectranthus edulis is an indigenous crop for the study area and Cordia cf. africana and Olea europea ssp. africana are reported for the first time in archaeological context of the whole region of Ethiopia. The study provided data on the ancient economy and ecology of the site in a region where archaeobotanical research is limited.*

**Keywords:** Mochena Borago, southern Ethiopia, carbonized seeds, mid-Holocene, ecology

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## **Introduction**

The transition from dry and cold phase of the Terminal Pleistocene to the wet and humid episode of the early Holocene was accompanied by significant changes in ecological and cultural developments. During the Terminal Pleistocene human-plant interactions were restricted to lowlands and in lower parts of the tropics, where conditions were relatively conducive for survival. Human beings were forced to rely on the utilization of specific plant types resilient to environmental stresses. The ameliorated environmental condition during the early Holocene (10,000-5,000 years BP), allowed plants to flourish and conquer many parts of the earth that were otherwise confined to specific territories (Nesbitt, 2001; Haaland, 1981, 1992; Haaland and Majid, 1995, & Haaland, 1999). It was at this time that human-plant interaction increased and incipient forms of agriculture emerged along the Nile Valley and the near east. The record in Ethiopia and the Horn is rather late with most archaeological evidences falling between mid and late Holocene (5,000 to 2,500 years BP) and after. One important site with a continuous archaeological and geological data to study human cultural and ecological evolutions is the site of Mochena Borago.

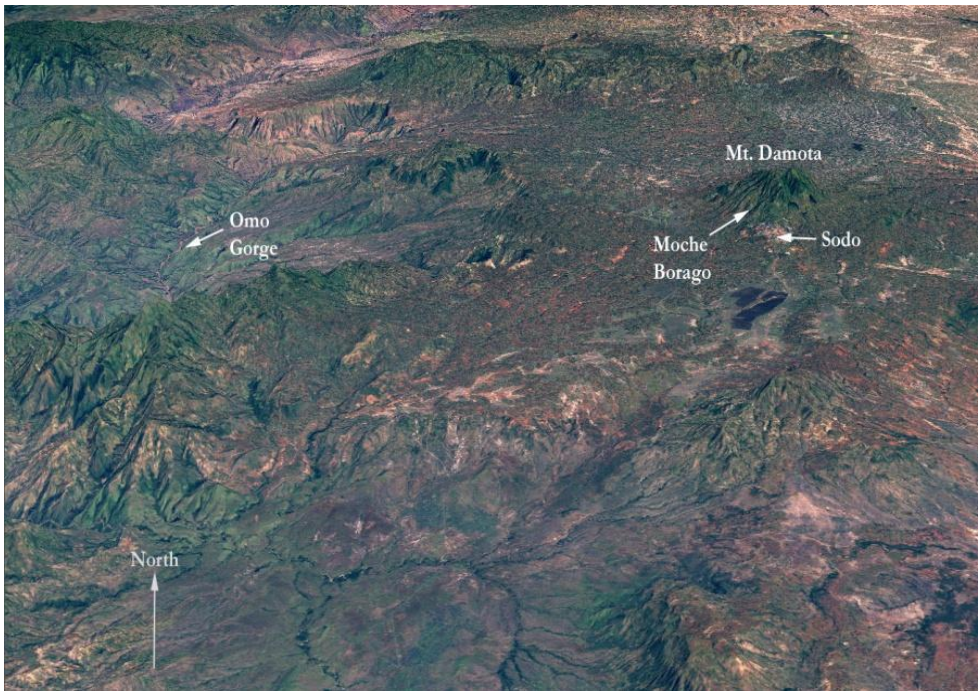
Mochena Borago has provided one of the most complete Late Pleistocene cultural sequences in the Horn of Africa. It renders cultural remains ranging from 53,000 BP to 1,480 BP (between 447 and 662 AD) (Brandt et al., 2012, & Brandt et al., 2017). The site is currently serving as a research gateway to test prominent hypotheses like “out of Africa theory II”, the dispersal of anatomically modern human beings out of Africa (between 70,000 and 50,000 years BP) and the “Refugium theory” which states that southwest highlands of Ethiopia served as a shelter during the large scale population migration of the hyper-arid phase of the last glacial maximum (LGM), 20,000 to 12,000 BP (Gutherz et al., 2000, & Brandt et al., 2012). The site was first discovered in 1995 during a survey of southern part of Ethiopia (Gutherz et al., 2000). The French Archaeological Mission carried out four excavation seasons between 1998 and 2001 (Lesur et al., 2007). Currently, a joint American and German expedition is exploring more on the Pleistocene contexts of the site.

The site of Mochena Borago is found in Wolayta Zone of the Southern Nations, Nationalities and Peoples Regional State of Ethiopia. Wolayta zone is geographically positioned between the lowland rift valley and lakes region to the East and Southeast and the southwestern Ethiopian highlands to the west. The rock shelter site of Mochena Borago is about 4 kilometers to the northwest of the city of Soddo, some writers claim that it is 3 kilometers (figure 1). Located at 2300 m.a.s.l. it is part of the western escarpment of Mount Damota, a dormant volcanic

chain with its maximum peak reaching 2908 meters. The Damota chain (Figure 2) is a source of fresh water resource for the locality since the water created by precipitation at the top flows down through the streams into the low-lying areas (Fisher, 2010). In front of the rock shelter there is a waterfall which pours down collecting water almost year round from the surrounding elevated chains. The rock shelter has a size of 600m<sup>2</sup>. This large sized rock shelter might have accommodated large human groups in the past (Gutherz et al., 2002; Lesur et al., 2007; Medhanit, 2015, & Brandt et al., 2017).



**Figure 1:** Top view of Mochena Borago rock shelter and its floor (from Brandt et al., 2012)



**Figure 2:** Mochena Borago rock shelter within Mt. Damota complex and the view of Mochena Borago rock shelter (After SWEAP and CRC 806/ SWEAP sources).

In 1998, the first excavations at Mochena Borago were undertaken under the leadership of Xavier Gutherz of the University of Montpellier (France) and the second was conducted in January and February of 2000 (Gutherz et al., 2000). Between these two field seasons, the team took geological samples from the rock shelter floor and walls. In addition to this, they also created three 4 m<sup>2</sup> test excavation areas. From these geological samples, the team was able to identify the presence of volcanic deposits in and around the site (Fisher, 2010). Excavations in three areas revealed stratified archeological deposits which contain abundant pottery, burnt and unburnt bone, “MSA and LSA” lithics (blade and flake debitage) within stratified sandy and salty deposits and numerous well- defined hearth features ( Gutherz et al., 2000). The findings in Test pit 1 were particularly rich, and this area was subsequently expanded to 6 m<sup>2</sup> during the 2000 field season. Excavation in Test pit 2 revealed fluvial activity and reworked deposits

with interstratified volcanic layers (Fisher, 2010). The final excavation was conducted in December 2001 and during this time Test pit 1 and Test pit 3 were connected in order to clarify ambiguities between the stratigraphic profiles of these areas (Gutherz et al., 2001). This correlation also helped to resolve the stratigraphic lateral associations of a rich bone and ash layer discovered in Test pit 3 (see the excavation grids, figure 4).

In the southern part of Ethiopia there is paucity in systematic researches specifically dealing with ancient plants with the objectives of reconstructing the beginning of early agriculture, human-plant interaction, past environment and climate change. The only encouraging studies to date are the ones conducted near lake Chamo by Foerster et al. (2015) and on the Gamo highlands by Arthur et al. (2019). The Chamo research covers the last 20ka years before present with plant data collected from cores of Lake Chamo marginal areas with additional comparisons from other archaeological sites in Southern highlands of Ethiopia and Northern Kenya. The study investigated the impact of climate-driven environmental change on prehistoric human populations.

In the Gamo highlands, Arthur et al. (2019) study the transition from Hunting and Gathering to an agropastoral way of life in the Gamo Highlands of Southern Ethiopia for three consecutive field seasons between 2007 and 2012. The study provides an archaeobotanical data for barley, finger millet and cotton seeds dated back to the medieval period (1416-1808 AD). From a similar medieval context barley and finger millet grains were recovered from the Nagassa mountain of Chenchä, in the Gamo highlands (Metasebia et al., 2015). Apart from the aforementioned studies most researchers and research missions consider the study of ancient plants as their sub objectives only for understanding environmental and climatic contexts while primarily dealing with human biological and cultural evolutions.

Hildebrand et al. (2010), in their Kaffa Archaeological Project (2004-2006) excavated ten rock shelters and caves to understand the Holocene archaeology of Kaffa area and the South Ethiopian region. From the cave at Kumali, with a preliminary identification of the botanical remains, it was possible to see leaves of Musaceae (not yet confirmed whether or not wild or domestic *Ensete ventricosum* or domestic Musa). Kumali also provided two partial seeds of *Coffea arabica*, in a context dated back to about 1,740 BP.

This archaeobotanical research is specifically conducted with the objectives of understanding the evolution of ancient agriculture in the region, human-plant interactions, change and continuity in the floral diversity of the mountain chains and resilience of some of the plant types.

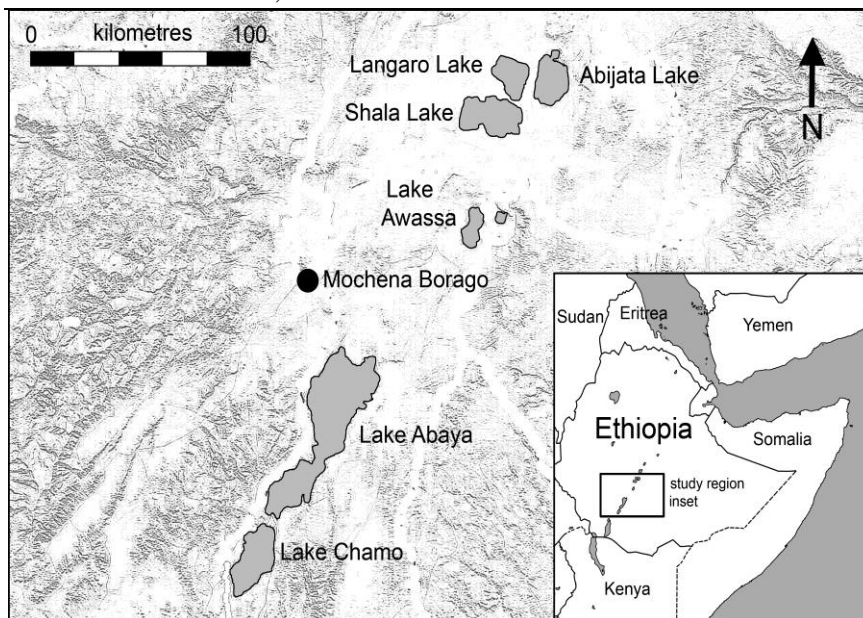
### Site description

Afro-montane forest accounts for the major part of the natural vegetation of the Damota complex (figure 2). This natural vegetation covers the altitudinal range of 1500 to 2600 m.a.s.l. (Tamrat, 2015). Its major components today near Mochena Borago Rock shelter are tall gymnosperm trees of *Podocarpus falcatus* and *Juniperus procera*. In the lower altitudinal zone (500 to 1500 m.a.s.l.), plant species like as euphorbia (*Euphorbia candelabrum*) and acacia species (mainly, *Acacia abyssinica*) are dominant (Fisher, 2010).

Currently, the natural vegetation of the study area (Figure, 3) is increasingly substituted by eucalyptus plantations (mainly *Eucalyptus globulus*) and crops like enset (*Ensete ventricosum*). The natural vegetation of the area includes *Pygeum africanum*, *Hagenia abyssinica*, *Erythrina abyssinica*, *Ilex mitis*, *Olea europea subsp. africana*, *Juniperus procera*, and *Podocarpus gracilior* (Gutherz et al., 2000). Farmers of Wolayita grow enset (*Ensete ventricosum*), maize (*Zea mays*), barley (*Hordeum vulgare*), sorghum (*sorghum bicolor*), finger millet (*Eleusine coracana*), and tef (*Eragrostis tef*) (Fisher, 2010.). *Sorghum bicolor*, *Eleusine coracana*, and *Eragrostis tef* are indigenous crops to the northern highlands of Ethiopia (Beldados, 2015).

During the 1998-2001 field seasons, the French expedition conducted excavations between 4 m<sup>2</sup> and 10 m<sup>2</sup>. Ninety archaeological levels were identified (Gutherz et al., 2000, & Lesur et al., 2013). They were interpreted as Pleistocene and Holocene living floors. The Holocene occupation is represented in layers 1 and 11 (see the stratigraphic sections, figure 5). Pleistocene occupation is represented in layers 12 and 19 (Lesur et al., 2007). Holocene layers 9 and 10 are characterized by an absence of pottery, the presence of fire places and significant amount of stone tools and animal remains. This phase was dated to 4370±70 (3330-2787 cal. BC) using charcoal. The second and the third Holocene layers 1-6 and 7-8 are defined by the availability of shaped pottery, fire places, an oven and stone tools. The AMS radiocarbon date from charcoal provided 2180±45 BP (485-55 cal. BC) for the second period. The third period was dated 1480± 60 BP (447-662 cal. AD) (all radiocarbon dates are calibrated according to Stuiver and Reimer (1993) taking into account a 2 sigma variation) (Gutherz et al., 2000, Lesur et al., 2013, & Lesur et al., 2007).

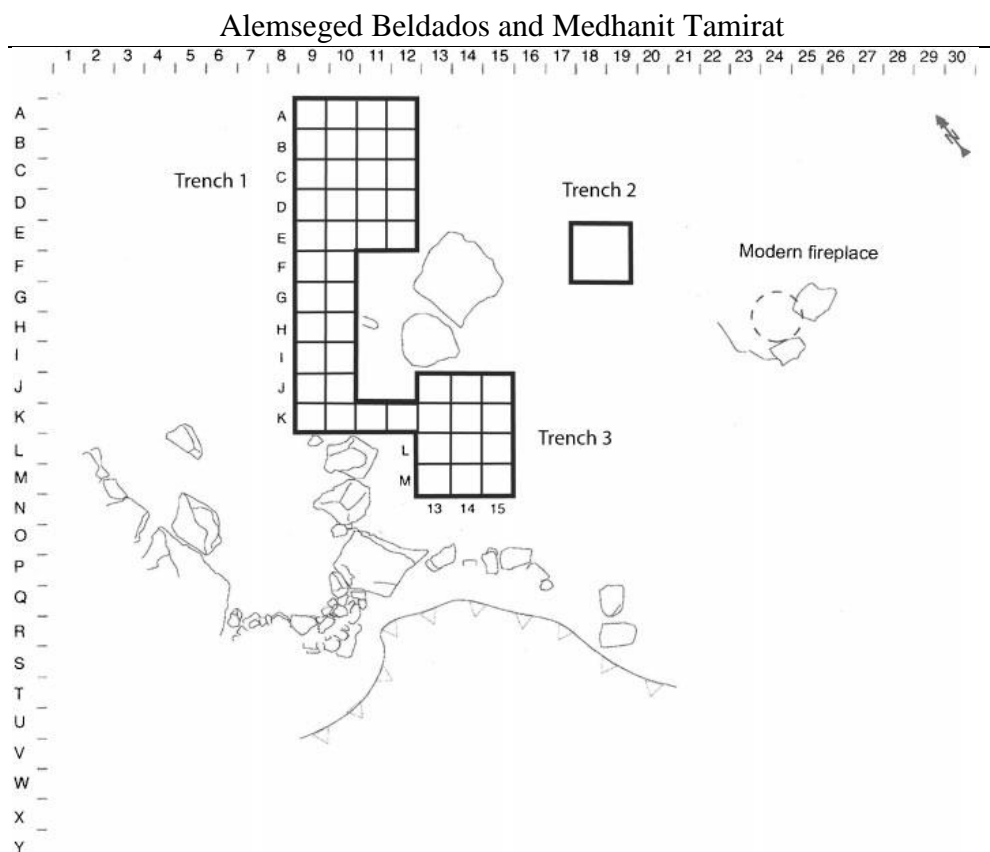




**Figure 3:** Map of the study area

### Materials and methods

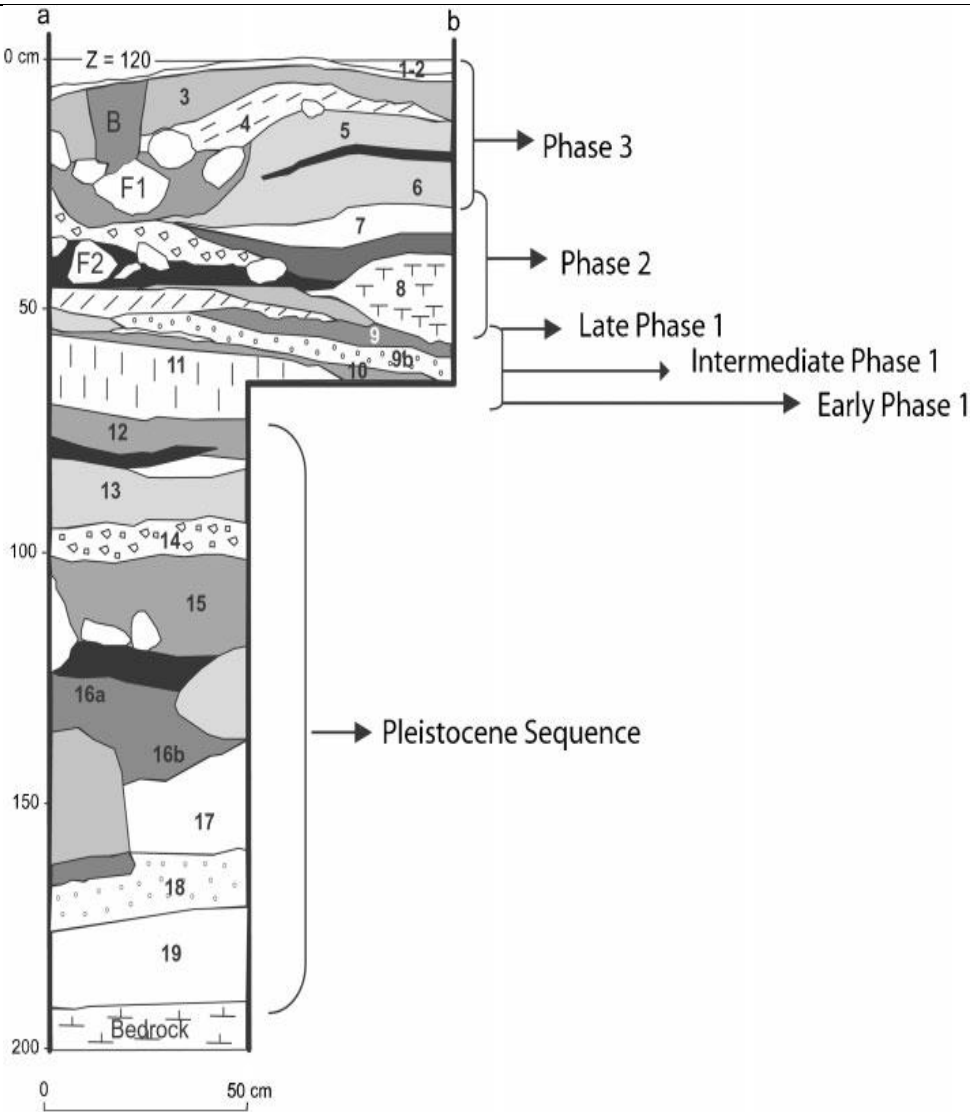
Soil samples for the study of macro fossil were collected by the French team in the field during the excavations in the years 2000 and 2001. The size of the sample varied between 0.3 and 0.7 depending on the type of the context being sampled. A total of 29 bags, from layers 1-6 and 7-8, were subjected for flotation. Out of the 29, 11 belong to the 2000 field season and the remaining 18 were from 2001. The flotation was carried out using a 2.0 mm mesh size sieve. To recover most of the organic remains, the flotation process was repeated 4 to 7 times. The floated carbonized remains, an equivalent of, 3.6 kilograms were subjected for archaeobotanical investigation at the laboratory of the National Museum of Ethiopia and archaeobotanical laboratory of the Institute of Archaeology, University College London (UCL). We sorted carbonized grains, fruit stones, and flotation of soil samples in Addis Ababa, the National Museum of Ethiopia. The identification of the botanical remains was done using comparative plant collections and reference materials and taking microscopic images of the seeds and fruit stones (as indicated in Majid, 2004).



**Figure 4:** Location of the excavated grids in the shelter (from Lesur et al., 2007)

The process of identifications involves classification of the botanical remains by type based on size and grain morphology, counting individual remains in each category, measuring their size using an integrated scale of Leica microscopes (Models DME and GMBH), comparison of the morphology of the seeds using modern seed comparative collections, Digital Seed Atlas of the Netherlands (Cappers et al., 2006) and Digital Atlas of economic plants in Archaeology (Neef et al., 2012).





**Figure 5:** stratigraphy of Mochena Borago (from Lesur et al., 2007) (B: burrow; F: fire place)

Seed analysis was conducted at 5-20X magnification. The identification process was aided by literature (Schoch et al., 1988; Neef et al., 2012). Length-breadth ratios of the seeds and fruit stones were also calculated in accordance with manual for cereal identification (Jacomet et al., 2006) to the closest species within genera. Images of the charred remains are taken by scanning electron microscope (SEM). Identification is made using the Digital Seed Atlases. Problematica (in this context, debatable issues that could arise from approaches in the identification process and nomenclature) were discussed with experts at UCL.

## **Results: Description of the recovered plant remains**

### **Type-1 *Sapindaceae* cf. *deinbollia***

A total of 55 carbonized grains of *Sapindaceae* cf. *Deinbollia* were recovered from the soil samples. It constitutes the largest share among the findings. About 147 genera and 2000 species that belong to genus *Deinbollia* grow in tropical Africa, Asia and Americas. Most of the species under this genus are cultivated for their edible fruits. People consume the fruits and leaves of this plant. The leaves in particular are eaten as spinach. The seeds produce foams and hence they are used as soap to wash clothes (Beentje, 1989).

*Deinbollia kilimandscharica* var. *adusta* (Radic.) and *Deinbollia killimandscharica* Taub. Var. *killimandscharica* are reported from Ethiopia. *D. Killimandscharica* is basically a small to medium sized tree or a shrub with unbranched trunk. The tree can grow 1, 2-8-12 m. The leaves, 20-80 cms in length, have a flower shape and dark brownish color (Hedberg and Edwards, 1989). The species grows between the altitudinal ranges of 600-2600 m.a.s.l along rivers and gorges. It is a component of evergreen moist or dry riverine forests. Outside of Ethiopia, it is reported from the tropical zones of Kenya, Tanzania and Uganda (SANBI, 2012).

Fruit stones of this genus are generally rounded and wider at the base and get thinner and narrower towards the apex. Small flat surface can be observed at the top of well-preserved remains. The flat surfaces are absent for smaller and immature fruit stones. For identification purpose to the closest species within family and genera, the fruit stones are measured for their length and breadth. They were 7.3-9.5mm long and 2.9-3.6mm wide. The length divided with breadth (L/B) ratio of the fruit stones measured was 2.5-2.6 mm. According to Jacomet et al., 2006, the short stubby type is somewhere below 1.5 and long thinner type is above 1.5. The measurement for *Sapindaceae* cf. *Deinbollia* belongs to the second category. The ratio is compared with other genera in the *Sapindaceae* family and *S. Cf. Deinbollia* is the closest choice.



**Figure 6:** image of *Sapindaceae cf. Deinbollia*

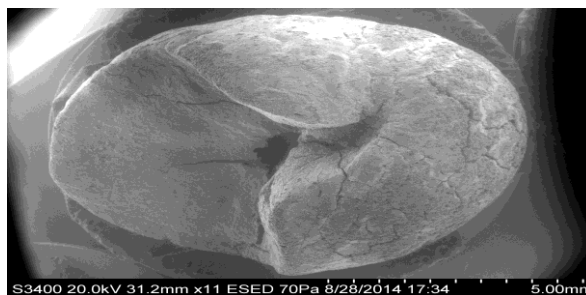
**Type-2 *Myrtaceae cf. syzigium guineense***

*Syzigium guineense* of the Myrtaceae family grows in different parts of Africa as both wild and domesticated. The tree can grow up to 10 to 25 m high. The trunk is large with a smooth bark at a younger stage of growth and rough and darker when older. Its branch bends down wards at full maturity. The leaves are shiny and smooth in both sides, younger leaves have a purple reddish color and they change their color to dark green at maturity. The flowers produce an attractive odor that attracts insects.

In southern Ethiopia, *Syzigium guineense* is planted for its shades. The wild plants grow at an elevation of 2100 m. It requires substantial amount of water and wet soil conditions to grow. It is a fallback food for farmers because fruits and leaves are consumable. It is known in different names among the different communities in the country; Dokma (in Amharic), Donke (in Ari), Baddessa (in Afan oromo), Ocha (in Wolayita). In English, it is commonly called water pear (Guinand and Dechassa, 2000). *Myrtaceae cf. Syzigium guineense* carbonized grains recovered from Mochena Borago constitutes among the second in terms of abundance (n=33) (figure 4). The same species was reported by Clare (2003) from Mid-Holocene context of Mochena Borago.

The fruit stones of this species are generally rounded with a small opening at the apex. The openings are curved and regular for most remains. The charred fruit stones were measured for their length and breadth. They were 9.5-11mm long and 2.8-4.6mm wide. The length divided with breadth (L/B) ratio of the fruit stones measured was 2.3-3.3 mm. The measurement for *S. guineense* belongs to the longer

and thinner category. The ratio is compared with other species in the *Syzigium* genera and *S. guineense* is the closest fit.



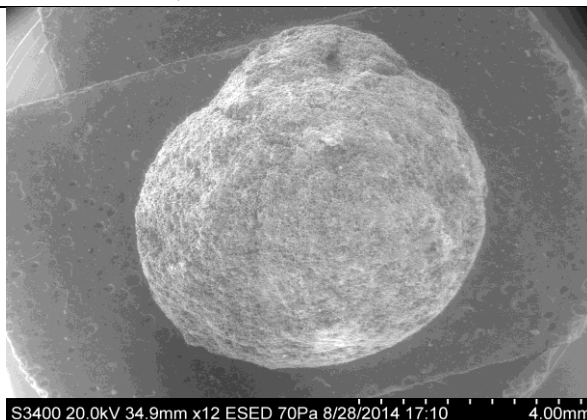
**Figure 7:** SEM image of *Syzigium guineense* (Compared with *Syzigium* seeds, Digital Atlas of Economic Plants, 2B, photo 27769:999)

### **Type-3 *Plectanthus edulis***

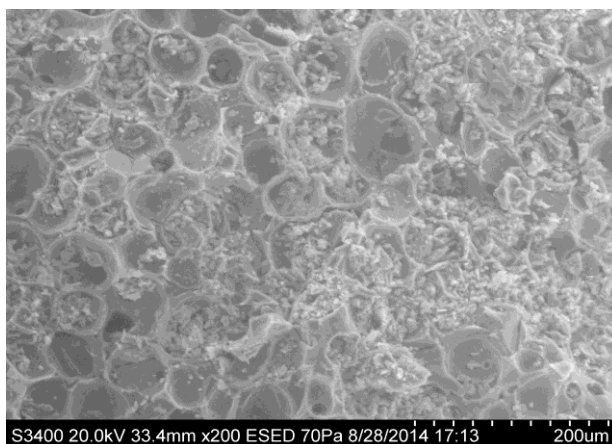
From the site at Mochena Borago a total of 9 carbonized seeds belonging to this species were recovered (figure 5, for the internal cell structure see figure 6). It is an annual plant in the Lamiaceae family. It is known as *Wolayta dinch* in Amharic language. *Wolayta* is the area where Mochena Borago occurs and *dinch* means potato. It is also locally known as *Dinicha Oromo*, *Wolayita dono*, *Gamo dinich*, *Gurage dinich*, *Agaw dinich*, or *Ethiopian Potato*. It is cultivated for its edible tubers in Ethiopia, where it is indigenous. The tuber is boiled or cooked before consumption. Leaves are also cooked and eaten as a vegetable in western parts of Ethiopia. It is also used as a medicine to cure different illnesses (Zemedede & Zerihun, 1997 & Mulugeta, 2008).

*Plectranthus edulis* (vatke) Agnew, syn. *Coleus edulis* has a long tradition in Ethiopia. It grows in North, South and Southwest parts of Ethiopia in mid and high elevations. The overall structure of this plant is similar with that of the Irish potato. The constituents of the plant include fruits, roots, stolons, the seed tubers, seeds, stem, branches, leaves and inflorescences (Mulugeta, 2008).

Seeds of *P. edulis* have rounded, irregular and rough exterior. Unlike other species in the genera, its apex is not protruding out. The seeds were 6.8-8.8mm long and 2.4-3.3mm wide. The length divided with breadth (L/B) ratio of the fruit stones measured was 2.6-2.8 mm. The ratio is compared with other species in the *Plecthranthus* genera and *P. edulis* is closer to the measurement.



**Figure 8:** SEM image of carbonized fruit stone of *P. edulis* (Compared with *Plecthrantus* seeds Digital Atlas of Economic Plants, 2B, photo 26542:828).



**Figure 9:** SEM image of the internal cell structure of *P. edulis*

**Type- 4 *Euphorbiaceae croton sp.***

Seven carbonized grains of this species are recovered from the floats (figure 7). The macrostachyus *Hochst* species of genus *Croton* is known as *bssana* or *bessena* in Amharic language and *masincho* in the local Wolayta/Sidama language, (Edwards, Tadesse, & Hedberg, 1995). It grows in all regions of Ethiopia. It adapts

well in the highlands between 1400 to 2500 m, along mountain slopes, lakes and rivers and fringes of cultivated fields. The fruits of this tree usually mature from March to October. It is an evergreen broad leaved tree that can grow up to 25 and 30 m tall. The stem has a cylindrical shape with a diameter of 50-80 cm. The bark is grayish, has no smooth surface rather demonstrate cracks. The leaves are dominantly light brown, simple and can grow up to 15x0.5mm. The seeds have a pointed top, light brown and grayish brown, fleshy. The maximum size of the seed is between 6-9x4-6 mm (Jansen, 1981).

In Ethiopia the powdered bark of this plant is used as a helpful medicine for constipation. People also treat themselves against venereal diseases by drinking the powdered bark and the root with milk and tea. Drinking the juice of the leaf will relief pain of women during labour and it also gives a remedy for headaches (Amare, 1976).

The fruit stones within the *Croton* genera have rounded and rough exterior with small and narrower opening at the apex. They were 6.8-8.2mm long and 2.3-3.2mm wide. The length divided with breadth (L/B) ratio was 2.5-2.9 mm. The fruits of most plants in these genera fall in this range.



**Figure 10:** SEM image of *Euphorbiaceae croton* sp. (compared with seeds of *Croton abyssinicus* and other species, Digital Atlas of Economic Plants, 2A, photo 18738:527).

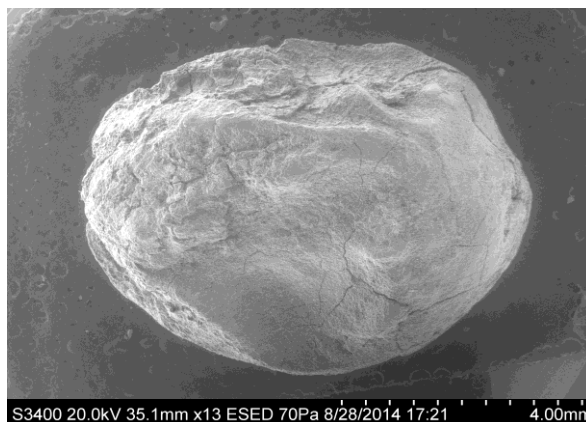
**Type-5 *Olea europea ssp. Africana***

*Olea europea ssp. africana* L. (Miller) is a species within the Oleacea family. Its synonym is *Olea africana*. It is commonly known as African olive and wild olive. It's an evergreen tree that can grow up to 10 m high. Its crown is rounded. It grows well in Mediterranean type of climate with fertile soil and abundant water, along river valleys and bush lands.

Leaves are shiny and grey green, and dorsal side may have yellowish and green color, elliptical shape, 5-10 cm long and 10-25 mm wide. The fruits are round with sharp tip at the top, 10-25 mm in length and 6 mm in diameter, fleshy and with green and blue color. The seed is brown and has 1 to 1.5 cm long.

The leaves of this plant can be served as a tea. The wood is utilized in the production of furniture. From the juice of the fruit, ink can be produced. Various body parts are also used for medicinal purposes including lowering blood pressure, to provide remedy for kidney mal-function and to treat sore throat (<http://www.plantzafrica.com>).

Only 1 carbonized fruit stone of *Olea europea ssp. Africana* was recovered among the samples (figure 8). This species was not reported by Clare (2003). *Olea europea* fruit stone has an elongated shape, thinner towards the two ends and a small projection at the apex. It has 6.8mm length and 2.2mm width. The length divided with breadth (L/B) ratio was 2.9 mm. Though not consumed, the identification of the species is the first of its kind from Mochena Borago and the whole region of Southern Ethiopia.



**Figure 11:** SEM image of *Olea europea ssp. Africana* (Compared with *Olea europea* seeds, Digital Atlas of Economic Plants, photo 28906:312)

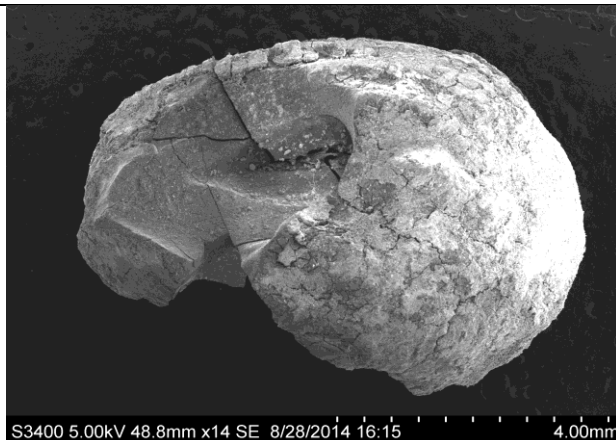


**Type- 6 *Cordia africana* Lam.**

In Amharic, it is known as *Wanza* and in the local *wolayta* language, it is called *makota*, *mokota*. In Ethiopia it is a familiar tree and it is known almost in all provinces. It can be found along rivers, in the fringes of forested areas and mountain slopes. It also commonly grows in the tropical zones of Africa; from Sudan to Guinea and in Southern part of the continent from Angola to Malawi. Outside of Africa, the plant adapts well in the tropical region of Arabia. It is an evergreen tree that can grow up to 25m high. The fruits have egg-like shape, 10-13 mm long and 9-11 mm in diameter, commonly taper at the top, fleshy and sweat when ripe, and have yellow-brown color. The fruit has four cavity, each having 0-1 seeds (Jansen, 1981). The length divided breadth (L/B) ration was 1.1. According to Jacomet et al., (2006), the ratio falls within the first category, short stubby type and this is an important character for identification.

In East Africa, the leaf is consumed by the Masai as a medicine for stomach worms. In Ethiopia, a number of medicinal uses of the plant are reported by Amare (1976). Fried leaves with butter can be used for all kinds of injury. The ash from the wood is also mixed with butter for skin disease locally known as ‘spider disease’.

Only 2 carbonized grains of this species are identified from the site (figure 9). Like *Olea europea ssp. Africana*, it is reported for the first time for the whole region of Southern Ethiopia. Though widely grown in the highlands of most parts of Ethiopia (Bruce, 1773), the carbonized fruits and wood fragments of this plant are rarely reported from archaeological contexts in the country. The archaeobotanical identification of the charred fruit from Mochena Borago is, therefore, the first of its kind.



**Figure 12:** SEM image of *Cordia africana* (Compared with *Cordia Africana* fruit stones, Digital Atlas of Economic Plants, 2A, photo 18888:265

#### **Type-7 Ebenaceae cf diospyros**

In Ethiopia the most commonly grown species is *Diospyros abyssinica* (Hiern) F. White. Its synonym is *Maba abyssinica* Hiern. It widely grows in Africa from Eritrea and Ethiopia in the East to Guinea and Mali in the west and to the south all the way to Angola and Mozambique (Beentje, 1994). It can be found in a wide diversity of forest lands and woodlands in elevation ranging from 200 to 2500 m.a.s.l. and rainfall conditions varying between 650 and 2050 mm (Ibid.).

It is a tall evergreen tree that can grow up to 30-40 m. The trunk does not produce branches and is straight and thinner; its diameter can be measured to 60-70 cm; its bark is smooth when young and becomes rough later. Leaves are elliptical in shape with 4-16 cm x 1-6 cm. The wood is currently used for construction of houses and furniture. It has also medicinal value. The bark and roots are exploited as a remedy for various diseases. Smashed leaves and roots can be used to treat malaria, dysentery and wounds. The smashed roots are also used for healing leprosy (Bekele, 2007). The fruit stone is unusually very long, wide at the center and narrower towards the two ends. It has 24.2mm length and 4.0mm width. The length divided with breadth (L/B) ratio was 6.05mm. Only 1 carbonized remain of this plant is recovered from Mochena Borago (figure 10). The same botanical remain was reported among the preliminary identification list of Clare (2003).



**Figure 13:** Microscopic image of *Ebenaceae* cf. *Diospyros* (Compared with *Diospyros macrophylla* and other fruit stones, Digital Atlas of Economic Plants, 2A, photo 24713:502)

### Discussion and conclusion

Out of the 112 identified seeds and fruit stones fifty five were Sapindaceae cf. *Deinbollia* type, thirty three Myrtaceae cf. *Syzigium guineense* type, nine *Plectranthus edulis*, seven Euphorbiaceae *Croton* sp., two *Cordia* cf. *africana*, one Ebenaceae cf. *Diospyros*, one *Olea europea* ssp. *africana*. The remaining four fruit stone fragments were unidentifiable. Except *Cordia* cf. *africana* and *Olea europea* ssp. *africana* (which are listed on preliminary identification of field report from Mochena Borago, by Clare in 2003, unpublished report), the rest are recovered for the first time from an archaeological context in Ethiopia. The carbonized botanical remains are recovered from stratigraphic layers of Early Phase 1, Intermediate Phase 1, Late Phase 1, Phase 2 and Phase 3 (figure 5). An AMS date from Charcoal fragments from Late Phase 1 gave  $4370 \pm 70$  (3330-2787 cal. BC). Table-1 summarizes the identified seeds and fruit stones from the site.

**Table 1:** Summary of the identified botanical remains

No.	Excavation square	Sample no.	Identification in no.							Total
			<i>Sapindaceae</i> <i>cf. deinhollia</i>	<i>Myrtaceae</i> <i>Syzigium guineense</i>	<i>Cordia</i> <i>cf. africana</i>	<i>Diospyros</i> <i>cf. Ebenaceae</i>	<i>Plectranth</i> <i>us edulis</i>	<i>Euphorbia</i> <i>ceae croton sp.</i>	<i>Olea</i> <i>europaea sub sp. africa</i>	
1	K11-K12	1010	5					1		6
2	K11-K12	1011	6					2		8
3	K11-K12	1024							1	1
4	K11-K12	1031							3	3
5	K11-K12	1039	3							3
6	K11-K12	1040		11						11
7	K11-K12	1049	3							3
8	K11-K12	1060		1			2			1
9	K11-K12	1063	1				1			3
10	K11-K12	1076	6							7
11	K9-12	1077	6							6
12	K11-K12	1082	4							4
13	K11-K12	1083	2				2			4
14	K9-12	1090				1				1
15	KL-13	3001		3						3
16	KU 3	3002	6	2	2					10
17	KL-13	3006	4							4
18	K-L/13-14	3010	9	16			9			34
Total			55	33	2	1	9	7	1	112

The 112 identified plants from archaeobotanical context are categorized in to seven plant species. Out of the seven, five (71.42%) plant species were found among the current vegetation of Mochena Borago rock shelter and its environs (Tamrat, 2015, & Guinand & Dechasa, 2000). These are *Syzigium guineense*, *Plectranthus edulis*, *Euphorbiaceaeae croton sp.*, *Cordia cf. africana* and *Olea europaea ssp. africa*. Among the five, two of them are still cultivated by the farmers of the area. These are *Plectranthus edulis* and *Olea europaea ssp. africana*.

The ethnobotanical and ethnoarchaeological researches conducted in the environs of the Mochena Borago rock shelter by the second author have assisted interpretations of the macrobotanical remains. The objectives of the study were to understand possible change and continuity in plant exploitation for a better interpretation of the archaeobotanical evidence and to appreciate the indigenous knowledge of the local inhabitants on local vegetations. According to the study, root crops and tubers are widely cultivated and consumed by the inhabitants. The

most common ones are *Ensete ventricosum*, *Plectranthus edulis*, *Ipomoea batatas* and *Colocasia esculenta* (Tamrat, 2015).

Charred remains of *Ensete ventricosum* was previously identified from the Late Holocene archaeological context of Mochena Borago (Claire, 2003). This is the only report to date concerning the presence of *E. Ventricosum* in ancient times in the context of the Late Holocene. Archaeobotanical researches in Wolayta and the Southern region is very rare. It is unfortunate that researchers are not engaged so far in the systematic study of reconstructing the utilization of enset as a staple food plant. Currently this plant is widely distributed in Southern and South western Ethiopia in Wolayta, Guraghe, Hadiya, Kambata, Gamo and Sidama. It is an important staple crop for more than 20 percent of the population living in the region. It is cultivated in an altitudinal range of 1100-3300 m.a.s.l and with mean annual temperature of 10-25<sup>0</sup>C and annual rainfall of 1000-1800 (Brandt et al., 1997).

*Plectranthus edulis*, an indigenous crop for Ethiopia, is widely cultivated in the study area. It is, however, recovered for the first time in archaeobotanical contexts from the study area. Currently this plant is widely cultivated for its edible tubers in many parts of Ethiopia. *Plectranthus edulis* is not only a plant species that is used as a food for the local people but also is one of the major crop under cultivation in Wolayta. Therefore, the existence of this species in both archaeobotanical and ethnobotanical contexts in the study area suggest that both the current and past societies of Wolayta were consuming the species as a source of food. It also indicates that there is continuity in the food system of the area as far as *Plectranthus edulis* is concerned.

*Olea europea ssp. Africana* was not reported from any archaeological site in the whole region of Southern Ethiopia. Researchers in the field of paleobotany and archaeobotany argue that in ancient times, this species only flourishes and is cultivated in Mediterranean region of Europe (Majid, 1989). This calls for more archaeobotanical research to understand the evolution and propagation of this plant.

*Cordia cf. africana* naturally grows around Mochena Borago rock shelter. However, nowadays the local people re-plant it in their home garden (Tamrat, 2015). They utilize its fruit as a source of food especially during the time of famine. In addition, its wood is used as a source of raw material to make different kinds of cultural objects. In addition to this, it is also used as a shade. It's often preferred as a resting place in traditional conflict resolution.

According to the archaeobotanical data, plant species like *Sapindaceae cf. Deinbollia*, *Myrtaceae cf. Syzigium guineense*, *Plectranthus edulis*, *Euphorbiaceae*

*Croton* sp., *Cordia* cf. *africana*, Ebenaceae cf. *Diospyros* were therefore, available as possible food crops for the local inhabitants of Mochena Borago during the Mid and late Holocene.

Depending on their biological characteristics, plants do have a special preference to certain environmental condition (Beldados, 2015, & Beldados, 2017 a & b). The amounts of rain fall or local hydrology, sunlight and soil types are basic factors that dictate plant growth. The degree of the availability of these resources differs from region to region and from one climatic zone to the other. Therefore, we can say that there is a direct relation between plant growth and environmental setting (Beldados, 2015). On the basis of this fact, an attempt is made to comment on the mid and late Holocene paleo- environment of Mochena Borago rock shelter and its environs. Table 2 presents the type of plants identified from the soil samples in terms of their ecological preference.

**Table 2:** Identified plant remains and their ecological preference

Site	Identified plant type	Preferred Environmental Condition (Elffers et al, 1964; DJ Acland ,1971, & El Amin, 1990)
<b>Mochena Borago</b>	<i>Cordia</i> cf. <i>africana</i>	Tropical
	<i>Diospyros</i> cf. Ebenaceae	Tropical and sub-tropical zone
	Euphorbiaceae cf. <i>Croton</i>	Tropical and sub-tropical zone
	Myrtaceae cf. <i>syzigium guineense</i>	Sub-tropical
	<i>Olea europaea</i> spp. africa	Sub-tropical
	<i>Plectranthus edulis</i>	Tropical and cool zone
	Sapindaceae cf. <i>Deinbollia</i>	Tropical

The botanical remains recovered from Mochena Borago were classified based on their preference to a certain ecological condition. Accordingly, the dominant type of setting is tropical and sub-tropical zone. Currently, Mt. Damota where Mochena Borago rock shelter is positioned and its environs are characterized by the same tropical and sub-tropical ecological zone. Hamilton (1982) suggested that mid Holocene climate and vegetation are mostly identical with the present day (see also Brandt & Gresham, 1991; Brandt, 1986, & Brandt & Brook, 1984). In the same way the evidence from Mochena Borago rock shelter indicated that the mid to late Holocene climatic condition is almost similar with the present day (see the summary for identified plants and their ecological preferences in table 2).

Mochena Borago is a very rich site with one of the most complete Late Pleistocene cultural sequences in the Horn of Africa. The cultural remains recovered from this site range in time between 53ka cal BP to 1480 BP (between 447 and 662 A.D). Despite the rich cultural sequence pre-historic and historic human-plant interaction and the ecological history of the site are poorly documented and reconstructed. This is also true for most archaeological and paleo-anthropological sites in Southern Ethiopia. This particular study based on the investigation of carbonized seeds and fruit stones from the Mid-late Holocene context of Mochena Borago partially demonstrated the subsistence pattern and past ecology of the study area and open up a research on a rather neglected and understudied field of study

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